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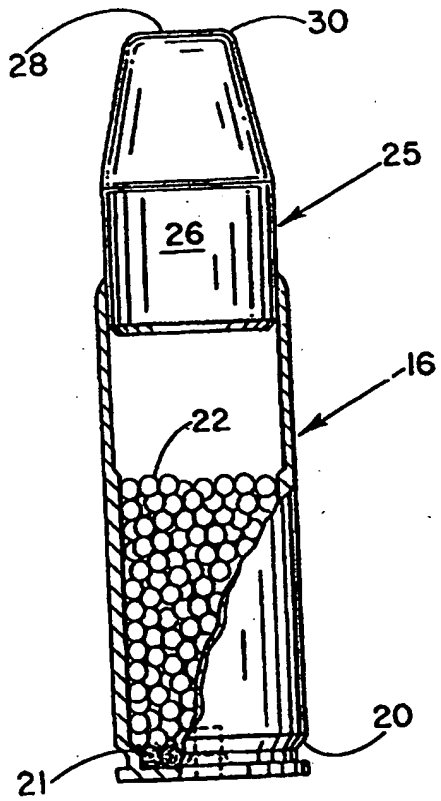
(57) Abstract

A non-toxic bullet (25) comprised primarily of zinc, and having smooth circumferential surfaces throughout, with its rear portion (26) being cylindrical and its forward portion (27) tapering inwardly and forwardly. When used in the simple non-encased form, or completely encased in a nylon or electroplated copper casing, it functions well as an inexpensive, non-toxic training round. When used as core in combination with a copper casing (59) enclosing the nose (58) and all but the rear end surface, my non-toxic bullet meets the requirements of a non-toxic non-frangible bullet. When my bullet is used as a core, with its rear end secured within the open end of a cup-shaped copper casing, it functions well as a non-toxic non-frangible bullet. If the core is constructed with weakened areas at the rear, and is mounted in the sanme type of cup-shaped copper casing, it performs in an improved manner as a frangible bullet.



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NON-TOXIC BULLET

I. DESCRIPTION

BACKGROUND OF THE INVENTION

In recent years, a need has developed for a non-toxic bullet having weight retaining properties such that it will qualify either as a frangible or non-frangible bullet.

The U.S. Federal Bureau of Investigation (FBI) has added its voice to such a demand and has defined a frangible bullet as one which retains less than 15% of its weight, after striking a three-eighths (3/8) inch steel plate at right angles. It has defined a non-frangible bullet as one which retains at least 75% of its weight after striking such a steel plate at right angles.

Recently, the FBI has indicated that it may be reconsidering these definitions, to raise the frangible bullet limit and reduce the non-frangible bullet limit. It is conceivable that perhaps a single bullet, which will meet the underlying requirements of both frangible and non-frangible bullets, may be designed.

In the present, however, it appears that the need for bullets which will break up upon striking such an object as the steel plate referred to above, and which is non-toxic, continues to exist. Likewise, the need continues for a non-toxic bullet which retains at least a major portion of its weight upon striking such a target.

Historically, bullets have been made out of lead or a combination of lead and copper. These materials have a number of characteristics and physical properties which make them well suited to bullet manufacturing and use. Low cost, drawability, low casting and annealing temperatures, and high density are a few of these desirable features.

Recently, a growing portion of the ammunition market has initiated requests for a product having performance requirements which cannot be met through the use of lead or copper jacketed/lead core bullets. The new requirements are that the bullets must not contain any toxic or heavy metals. The new bullet should also have a limited range, compared to a copper-jacketed lead core bullet.

The various ammunition manufacturers have submitted two possible solutions to the above needs. A solid copper bullet has been proposed to satisfy the non-frangible requirements. A

plastic/bronze powder, mixed together and molded into a bullet has been submitted to meet the frangible bullet requirements.

The plastic frangible bullet identified above is not satisfactory because the material from which it is made is very expensive, and its density is so low that the bullet will not function reliably in self-loading firearms.

The copper bullet proposed above is likewise not satisfactory because the copper material is relatively expensive, it is difficult to machine, and it is harder than a copper jacketed lead/core bullet, which results in a comparably lower velocity for any given pressure generated by the propellant. Thus, a solid copper bullet leaves much to be desired.

The only prior use, to the best of my knowledge, of zinc as the primary ingredient of a bullet, is that shown in U.K. Patent No. 27342 issued to Hookham et al on December 1, 1906. This patent teaches the use of a cupro-nickel envelope about a core of low specific gravity, such as zinc, with the latter being provided with grooves formed in the circumferential surface of the core into which the envelope embeds itself. This serves a dual purpose of preventing gas from entering between the core and the envelope and enables the metal harder than lead to take the riflings of the barrel. In addition, the rear end of this bullet is comprised of a slug of lead which is non-uniform in the diameter of its circumferential surfaces. Thus, the bullet shown in said U.K. patent is toxic, has rough circumferential surfaces, is not of uniform diameter throughout its rear portion, and approximately one-fourth (1/4) thereof is made up of lead.

U.S. Patent No. 4,811,966 discloses a solid projectile made of approximately 61.5% copper, 35% zinc, 3% lead and 0.5% tin. The high copper content makes it expensive and incorporates the other adverse features identified hereinabove. It is designed to improve and increase penetration. It is intended to be non-expansive and, consequently, would be classed as non-frangible.

U.S. Patent No. 5,208,424 discloses a hollow point jacketed bullet made of lead or a lead alloy and having a portion of the jacket extending within the hollow open front of the bullet. A plurality of radial slits are formed in the portion of the jacket which extends into the hollow front end of the bullet. Reinforced pointed prongs are positioned between the slits and

extend into the opening which extends axially rearwardly beyond the prongs. No suggestion to use zinc in the bullet is contained in this patent.

U.S. Patent No. 5,164,533 teaches a method for assembling a pyrotechnically initiated projectile. It has a nose incendiary, a penetrator core, a high explosive and an overall jacket. The penetrator core 14 is comprised of a tungsten alloy. No suggestion to use zinc, as a substitute, is contained in the patent.

U.S. Patent No. 4,685,397 discloses a lead-free, plastics-free hunting bullet having a hollow nose which is provided with a cap having wedge-shaped projections which move rearwardly upon impact with a target to cause the bullet to be ruptured and spread into tongues or petals. The bullet maintains its weight and, since it is lead-free and plastics-free, it cannot transfer these foreign materials to the body of the animal being hunted. The body of the bullet is made of tombac, copper or the like. No suggestion to use zinc, in any form, is made.

U.S. Patent No. 4,610,061 shows a hollow nosed projectile formed of lead and provided with a cup-like aluminum jacket, the forward open end of which is swaged inwardly over the hollow area of the lead core. The jacket is weakened at the nose of the bullet to promote upset of the bullet. No suggestion is made that any material other than lead should be utilized in the core.

U.S. Patent No. 4,503,777 shows a semi-jacketed molded bullet in which a small portion of the core extends through the hole in the bottom of the jacket and forms a radially outwardly extending flange which secures the core to the jacket. The core is made of a soft material, such as lead, and the jacket is made of a relatively hard material such as copper, brass, zinc, bullet gilding material, or equivalent, with bullet gilding material being preferred. No suggestion to use zinc as a core material is contained in the patent.

The above patents were developed in a search conducted for any suggestion of the use of zinc as a primary core material for bullets. The only patent found which contains such a suggestion is U.K. Patent No. 27342 which teaches that, if the core is to be made of zinc, its external surfaces must be grooved in order to take advantage of the riflings of the barrel of the rifle from

which it is fired. The patent states that special treatment is required to make such a core serviceable as a rifle bullet. That special treatment is defined as cutting grooves in the circumferential surfaces of the zinc core. The purpose is always the same, that is, to reduce the surface of the metal to be compressed by the rifling. The patent also teaches that the base of the core should have a disc or plug of lead into which the turn-over of the envelope is embedded to prevent gas from entering the core and envelope, and to enable the base of the bullet to be set up, "an effect which it is difficult or impossible to obtain with zinc."

In recent years, the desirability of using a non-toxic bullet, if one could be found, has been recognized and consequently a need for same exists. To date no non-toxic bullet, which is capable of being manufactured at reasonable expense, has been offered in the trade or even suggested. Since both zinc and copper are considered to be non-toxic, the embodiments of my invention, as described hereinafter meet this need for the first time.

In addition to the above, there is a need for a bullet which can be manufactured relatively inexpensively, and has a limited range. This feature is particularly desirable in bullets used in training rounds. At least one of the preferred embodiments of my invention meets this requirement.

BRIEF SUMMARY OF THE INVENTION

The invention in its simplest embodiment includes the conception of a non-toxic bullet formed of a metal slug, made up primarily of zinc and having a generally cylindrical rear portion and an inwardly tapering forward portion, and having smooth circumferential surfaces throughout.

In additional preferred forms, the non-toxic bullet of the invention is capable of functioning either as a non-toxic frangible or a non-toxic non-frangible bullet (as defined herein) with only minor variations in its construction. In such bullets, I use the zinc slug as a core and encase the rear end of the slug within a cup-shaped copper casing. In the case of the frangible bullet, I also weaken rear areas of the slug.

In at least one of its preferred embodiments, the non-toxic bullet may be capable of meeting the requirements of both

frangible and non-frangible bullets. Thus, the weight-retaining characteristics of the primarily zinc slug, when used as a core within a cup-shaped copper casing, without being weakened, closely approaches currently established lower limits of non-frangible bullets and may indeed meet the requirements of the FBI for same in the future.

In each of the preferred embodiments, the core of the bullet is made up of at least 94% zinc.

In its simplest preferred form, my non-toxic bullet may be in a non-jacketed form and will function well as a training round. Such a bullet is substantially less expensive to produce.

The embodiments of my invention may be manufactured by using (1) machining techniques, (2) die-cast techniques, or (3) cold-forming techniques. The percentage of alloy which is included with the zinc, in each of the embodiments, depends upon the manufacturing technique which is used. This is true because zinc is a relatively hard material and some manufacturing techniques require slightly softer material.

In addition to the above, each of the embodiments of my invention meets the need for bullets which have sufficient mass to be able to function in automatically loading firearms, which are either gas or recoil operated. Plastic bullets are too light to perform satisfactorily in such firearms. A comparable metal, copper, is too expensive to produce for such purposes. The preferred forms of my invention perform in a highly satisfactory manner in such firearms, and are substantially less expensive and, consequently, are highly desirable for use as non-toxic training rounds, as compared to bullets of other manufacture.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

Fig. 1 is a partial sectional view of a conventional cartridge, showing the prior art;

Fig. 2 is a side elevational view of the preferred embodiment of the invention, with a portion broken away, and showing the bullet shape and smooth circumferential surfaces;

Fig. 3 is a front end plan view of the bullet shown in Fig. 2;

Fig. 4 is a partial sectional view showing the bullet of Fig. 2 installed within a conventional cartridge casing;

Fig. 5 is a partial sectional view of the bullet of Fig. 2 enveloped in a nylon casing;

Fig. 6 is a partial sectional view of the bullet of Fig. 2 enveloped in an electroplated copper casing;

Fig. 7 is a partial sectional view of another preferred embodiment of the invention, having the rear end portion encased in a cup-shaped copper casing;

Fig. 8 is a partial sectional view of the bullet shown in Fig. 7 installed within a conventional cartridge casing;

Fig. 9 is a partial sectional view of another preferred embodiment of the invention, encased within a cup-shaped copper casing, and having weakened areas at its rear end to induce frangibility;

Fig. 10 is a partial sectional view of the bullet shown in Fig. 9 installed within a conventional casing;

Fig. 11 is a rear end plan view of the core of the bullet shown in Fig. 9, showing the weakened areas provided to induce frangibility;

Fig. 12 is a perspective view of the bullet shown in Fig. 9 after it has struck a 3/8 inch steel plate and showing its frangibility;

Fig. 13 is a partial sectional view of another preferred form of the invention which is non-frangible and has the nose of the core completely encased in copper, and with only a portion of the rear end of the core encased;

Fig. 14 is a partial sectional view of the bullet of Fig. 13 installed within a conventional copper cartridge casing; and

Fig. 15 is a rear end plan view of the bullet shown in Figs. 13 and 14.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a conventional cartridge identified generally by the numeral 16. As shown, it is comprised of a brass cartridge casing 17 having an open mouth 18 which is crimped inwardly around the lead bullet 19. The casing 17 accommodates a supply of primer 21 and adjacent propellant 22, each of which

burns upon firing. The brass casing which is utilized in the embodiments of my invention, as shown and described herein, is highly similar to the casing 16 and, therefore, may be numbered accordingly.

The embodiments shown in Figs. 2-4, inclusive, discloses my invention in its simplest form in that a slug 25 is comprised solely, or at least primarily, of zinc and is characterized by a cylindrical rear portion 26 and a forward portion 27 which tapers inwardly toward its forward end 28. The forward end 28 and the rear end 29 extend radially and are, therefore, parallel. The bullet 25 is characterized by the fact that it is comprised throughout primarily of zinc, and the fact that it is not encased, and its rear portion being cylindrical in shape and having smooth exterior surfaces throughout. The inwardly tapering forward portion 27 similarly has smooth exterior surfaces. Both the rear portion 26 and the forward portion 27 are formed symmetrically with respect to the longitudinal axis of the bullet.

The bullet 25, as shown, terminates in a slight radius of .04 inches as at 30. The overall length of the bullet is .625 inches +/- .003". The length of the forward portion 27 is .316 inches +/- .003". The diameter of the forward end, prior to being radiused, is .2207 inches. The outer surface of the forward portion 27 tapers inwardly at an angle of approximately 24° relative to the longitudinal axis of the bullet. The slight bevel 31 at the rear end of the bullet has an axial length of .015 inches +/- .005", and the angle of the bevel 31 is 45°.

The die-casting zinc alloy which is utilized in each embodiment of my invention is #3 (A.K.A. ZAMACK #3). I have also used an unalloyed zinc #302. The composition of these alloys is provided in greater detail in suitable alloy reference material such as Metals Handbook, © 1985, American Society for Metals, Metals Park, Ohio 44073. The angle of taper of the forward portion 27 of the bullet shown in Fig. 2 is 24° off the longitudinal axis of the bullet.

Fig. 4 shows the bullet 25 of Fig. 2 mounted in a conventional brass cartridge casing 16, which has the usual priming material 21 and propellant 22. I have found that the bullet 25 of this cartridge has weight-retaining characteristics

of approximately 45-65%. As a consequence, it is an ideal training round and is substantially less expensive than training rounds heretofore known, in view of the fact that the cost of applying a casing, which surrounds the bullet, has been eliminated.

Fig. 5 shows the same bullet as is shown in Fig. 2, encased, as a core member, in plastic throughout. This core 32 is of the same construction as element 25 of Fig. 2 and is completely enclosed within the nylon envelope 33. This construction also functions very well as a training round. Because the core can be encased in nylon at relatively low expense and it functions well when used in training, it also qualifies highly as a training round. It also has weight-retaining characteristics of approximately 45-65%. When used as a training round, this bullet is mounted in a casing such as shown in Fig. 4 and in the same manner.

Fig. 6 shows a third type of bullet 34, which is likewise designed to be utilized as a training round. As shown, it has a core 35 which is identical to the bullet 25 shown in Fig. 2. The core 35 is completely encased, by electroplating or chemical plating, with an envelope 36, made of copper. This envelope is very thin. Here again, the cost of producing this bullet is relatively low and, since it has weight-retaining functions approximating 45-65%, it too is a highly desirable bullet for use in training rounds. When used, it is mounted, of course, in the mouth of a brass cartridge casing such as is shown in Fig. 4.

Figs. 7-8 show another preferred form of the invention in which an all-zinc, or primarily all-zinc, core 37 is mounted within the open end of a cup-shaped copper casing 38. The core 37 is substantially identical to the core 25 shown in Fig. 2 in that its rear end portion is cylindrical in shape and the entire circumferential surface of the core is smooth.

In the manufacture of the bullet, which is indicated generally by the numeral 39, the cup-like copper casing 38 is cylindrical in shape and has a closed bottom and open mouth. The core 37 is inserted into the casing 38, so that the rear end thereof bears against the bottom of the casing 38, and the upper portion of the casing is then drawn inwardly around the inwardly tapering forward portion 40 of the core. The portion 40 has an

intermediate circumferential surface 40a which is parallel to the circumferential surface of the cylindrical rear portion of the core, but extends only a short distance axially. The upper portion of the casing is drawn inwardly around and against this surface 40a. As shown, the forward end 41 of the core 37 is parallel to its rear end and to the bottom wall of the casing 38 and is disposed forwardly beyond the mouth of the casing.

Fig. 8 shows the bullet 39 mounted within a cartridge casing 42 which is substantially identical to the cartridge casing shown in Fig. 4. It is provided with the corresponding primer material 43 and propellant 44. This bullet 39, when fired, has weight-retaining characteristics of 45-65%. We believe this bullet has definite possibilities of possibly qualifying as a non-frangible bullet, if and when the FBI lowers its limits as anticipated.

Fig. 9 shows another preferred form of my invention in which the bullet 45 has a zinc, or primarily zinc core 46, the rear end portion of which is cylindrical in shape and, with the inwardly tapering forward portion, has smooth circumferential surfaces, and is further characterized by the presence of weakened areas at its rear end surface, as best shown in Fig. 11. A pair of transverse grooves 47, as shown in Fig. 11, is formed in the rear end of the zinc core 46. These grooves 47 extend at right angles to each other and have a depth of approximately .250 inches and a width of approximately .010 inches. The forward end portion 48 of the bullet 45 tapers inwardly, as best shown in Fig. 9, and the nose is slightly rounded. The degree of taper relative to the longitudinal axis is approximately 24°.

As shown, the rear portion of the zinc core 46 is completely encased within a cup-shaped copper casing 49. This copper casing, like the one shown in Figs. 7-8, is cylindrical in shape and has smooth circumferential surfaces, a closed bottom, and an open mouth into which the core 46 is positioned. Thereafter, the open mouth portions of the casing are drawn inwardly to enclose the more rear areas of the forward inwardly tapering portion 48 of the core.

Fig. 10 shows the bullet 45 of Fig. 9 mounted within a copper cartridge casing 50, which is substantially identical to the casing 16 shown in Fig. 4, and includes the usual primer 51

and propellant 52. Upon being fired, the impact of the bullet striking the target, causes the nose portion of the bullet to mushroom. At the same time, the weakened areas defined by the grooves 47 at the rear end of the core 46, as shown in Fig. 12, cause various segments of the bullet to separate from each other. Also, we have found that, upon occasion, a circular disk 53, which previously constituted the bottom wall of the copper casing 49, is cut free and separates from the cylindrical walls of the casing. The weight-retaining characteristics of this bullet is approximately 15-35%. As a consequence, this bullet qualifies very well as a frangible bullet, when fired at a three-eighths (3/8) inch steel plate. It also qualifies very well as a satisfactory training round.

Fig. 13-15, inclusive, show another embodiment of my invention in which the core 55 is, like each of the other embodiments, comprised primarily of zinc. In each of the forms described herein, the slug or core is comprised of at least 94% zinc and the remaining 1%-6% is comprised of alloy metals, none of which are toxic. As shown, the rear portion 56 of the core 55 is cylindrical in shape, while the forwardly extending more forward portion tapers inwardly at approximately a 24° angle to the longitudinal axis of the core. As shown, the outer circumferential surfaces of the core are smooth.

The nose 58 of the forwardly extending portion 57 and the forwardly and inwardly tapering portion 57 and cylindrical rear portion 56, as shown in Fig. 13, are each completely encased in a copper casing 59. The casing 59 is of such a depth so that, when the core 55 is positioned therewithin, the rear open end of the casing 59 extends slightly beyond the rear end 60 of the core 56. Thereafter, the mouth portion 61 of the casing 59 is swaged inwardly, as shown in Fig. 15, so as to securely retain the core 55 within the casing 59. The portions which are swaged inwardly around the rear end of the core 55, and do not cover the same entirely, have been identified by the numeral 61.

Fig. 14 shows the bullet displayed in Fig. 13 mounted within the mouth 63 of the conventional brass cartridge casing 64. As shown, the casing 64 is provided with the usual priming mixture 65 and propellant 66. When fired, the bullet 55 retains 60-80% of its weight upon impact with the target. It will be

noted that, in this embodiment of the invention, the entire nose of the core is encased within the copper casing 59 and that this casing protects the core 56 so that it remains substantially intact while the casing breaks up and frequently disappears altogether. This embodiment of the invention, therefore, clearly meets the requirements for a toxic non-frangible bullet. In addition, it may be used as a non-toxic training round, since it can be manufactured relatively inexpensively.

From the above, it can be seen that I have developed a non-toxic bullet which, in its various embodiments forms, meets the requirements for a non-toxic frangible and non-toxic non-frangible bullet. In addition, I have developed a non-toxic bullet highly suitable for use as a training round. Each of the embodiments has incorporated therein the basic invention of a bullet which has a core that is either 100% zinc or at least 94% zinc, and is characterized by cylindrical rear portions and inwardly tapering forward portions, the outer surfaces of each of which are smooth.

The basic construction, which does not require a casing, is suitable and much to be preferred as a training round. The other embodiments involve the use of a core-encasing material which is non-toxic. Depending upon the manner and area in which the casing is applied to the core (which is the basic invention), the resultant bullet is suitable for use either as a training round or as a non-frangible bullet or as a frangible bullet, depending upon the percentage of weight which is retained by the bullet upon impact. The degree of retention is determined by the nature and manner of application of the casing to the core member.

As indicated previously, an added advantage provided by the above embodiments is that they may be manufactured relatively inexpensively. Their manufacture can be accomplished by utilizing any one of die-casting methods, machining, or cold-forming techniques.

In considering this invention, it should be remembered that the present disclosure is illustrative only and the scope of the invention should be determined by the appended claims.

II. CLAIMS

1. A non-toxic bullet comprising,
   (a) a slug member having a generally cylindrical rear portion and an inwardly tapering forward portion and having smooth circumferential surfaces throughout its length,
   (b) said slug member being comprised throughout primarily of zinc.
2. The bullet defined in Claim 1, wherein said rear portion of said slug member is of uniform diameter in its entirety.
3. The bullet defined in Claim 1, wherein said rear portion of said slug member is of uniform diameter and extends throughout substantially half the length of said slug member.
4. The bullet defined in Claim 1, wherein said slug member retains approximately 45-65% of its weight after striking a 3/8 inch thick steel plate while moving at approximately 1200 feet per second.
5. The bullet defined in Claim 1, wherein said slug member is devoid of metal encasing structure.
6. The bullet defined in Claim 1, wherein said slug member is comprised of pure zinc throughout.
7. The bullet defined in Claim 1, wherein said slug member is comprised of at least 94% zinc.
8. The bullet defined in Claim 1, and
   (c) a metal cartridge casing having head, rim, main body, and mouth portions;
   (d) primer compound located adjacent said rim portion and bearing against said head portion;
   (e) propellant located within said main body portion in close proximity to said primer compound; and
   (f) said slug member being secured within said metal casing with its cylindrical rear portion disposed within said mouth portion of said casing and having its tapered forward portion extending forwardly relative to said casing.
9. The bullet defined in Claim 1, wherein said slug member is completely encased in nylon.

10. The bullet defined in Claim 1, wherein said slug member is devoid of metal-encasing structure.
11. The bullet defined in Claim 1, wherein said slug member has weight-retaining characteristics such that it retains 45-65% of its weight upon impact with a target.
12. The bullet defined in Claim 1, wherein said slug member is completely encased in copper.
13. A non-toxic bullet comprising,
    (a) a generally cylindrical casing having a substantially closed rear end and an open forward end and being comprised primarily of copper, and
    (b) a core member secured within said casing and extending forwardly beyond the forward end thereof, said core member being comprised throughout primarily of zinc and having a generally cylindrical rear portion and an inwardly tapering forward portion and having smooth circumferential surfaces throughout.
14. The bullet defined in Claim 13, wherein said forward end of said casing terminates adjacent the forward portion of said core member.
15. The bullet defined in Claim 13, wherein said forward end of said casing is swaged inwardly around and against said inwardly tapering forward portion of said core member.
16. The bullet defined in Claim 13, wherein said core member is cylindrical in shape throughout substantially half of its length.
17. The bullet defined in Claim 13, wherein the rear portion of said core member is characterized by weakened areas designed to permit at least partial segment separation upon impact.
18. The bullet defined in Claim 13, wherein said core member has parallel rear end and nose surfaces.
19. The bullet defined in Claim 13, wherein said core member has an axially extending intermediate circumferential surface disposed within its tapering forward portion and extending parallel to said cylindrical rear portion.
20. The bullet defined in Claim 13, wherein said core member has an axially extending intermediate circumferential surface disposed within its tapering forward portion extending parallel to said cylindrical rear portion and said forward

end of said casing bears against said intermediate circumferential surface of said core member.

21. The bullet defined in Claim 13, wherein said core member is comprised of at least 94% zinc.

22. The bullet defined in Claim 13, and

(c) a metal cartridge casing having head, rim, main body, and mouth portions;

(d) primer compound located within said rim portion and bearing against said head portion;

(e) propellant located within said main body portion in close proximity to said primer compound; and

(f) said cylindrical casing and said core member being secured within said mouth portions of said metal cartridge casing in tight-fitting relation and extending forwardly therefrom.

23. The bullet defined in Claim 22, wherein the portion of said core member extending beyond the forward end of said cartridge casing is tapered inwardly throughout.

24. The bullet defined in Claim 13, wherein said core member has a rear end portion which is structurally weakened to facilitate rupture of said core member upon impact of said core member with a target.

25. The bullet defined in Claim 13, wherein said core member includes a plurality of separate segments encased within said casing and separating from each other upon impact of said core member with a target.

26. The bullet defined in Claim 13, wherein said core member has a rear end portion comprised of a plurality of weakened areas encased within a rear portion of said casing and separating from each other upon impact of said core member with a target.

27. The bullet defined in Claim 13, wherein said core member and said casing have weight-retaining characteristics such that said core member retains 45-65% of its weight upon impact with a target.

28. The bullet defined in Claim 13, wherein said core member and said casing have weight-retaining characteristics such that said core member retains 15-35% of its weight upon impact with a target.

29. A non-toxic bullet, comprising,
    (a) a generally cylindrical casing comprised primarily of copper,
    (b) a core member secured within said casing and being made primarily of zinc, and having a generally cylindrical rear portion and an inwardly tapering forward portion, a rear end, and cylindrical circumferential surfaces,
    (c) said casing surrounding said forward portion and the major portion of said circumferential surfaces in tight-fitting relation and extending rearwardly beyond said core member and across at least a portion of the rear end of said core member, and
    (d) said circumferential surfaces being smooth throughout.
30. The bullet defined in Claim 29, wherein said casing extends radially inwardly a short distance across the rear end of said core member.
31. The bullet defined in Claim 29, wherein said casing encases said tapering forward portion entirely.
32. The bullet defined in Claim 29, wherein said casing encases the entire exterior surface of said core member except for a central area of the rear end of said core member.
33. The bullet defined in Claim 29, wherein said casing has rear end terminal portions swaged over the rear end of said core member.
34. The bullet defined in Claim 29, and
    (c) a brass cartridge casing having head, rim, main body, and mouth portions;
    (d) primer compound located within said rim portion and bearing against said head portion;
    (e) propellant located within said main body portion in close proximity to said primer compound; and
    (f) said core member being secured within said cartridge casing with its cylindrical rear portion disposed within said mouth portion of said cartridge casing and having its tapered forward portion extending forwardly relative to said cartridge casing.
35. The bullet defined in Claim 29 wherein said core member and said casing have weight-retaining characteristics such that

said core member retains 60-80% of its weight upon impact with a target.

AMENDED CLAIMS
[received by the International bureau
on 20 May 1996 (20.05.1996);
original claims 1, 4, 8, 11, 13, 22, 23, 27, 29 and 34
amended; remaining claims unchanged (5 pages)]

1. A non-toxic rifle bullet comprising,
   (a) a slug member having a generally cylindrical rear portion and an inwardly tapering forward portion and having smooth circumferential surfaces throughout its length,
   (b) said slug member being comprised throughout primarily of zinc.
2. The bullet defined in Claim 1, wherein said rear portion of said slug member is of uniform diameter in its entirety.
3. The bullet defined in Claim 1, wherein said rear portion of said slug member is of uniform diameter and extends throughout substantially half the length of said slug member.
4. The bullet defined in Claim 1, wherein said slug member is constructed and arranged so as to retain approximately 45-65% of its weight after striking a 3/8 inch thick steel plate while moving at approximately 1200 feet per second.
5. The bullet defined in Claim 1, wherein said slug member is devoid of metal encasing structure.
6. The bullet defined in Claim 1, wherein said slug member is comprised of pure zinc throughout.
7. The bullet defined in Claim 1, wherein said slug member is comprised of at least 94% zinc.
8. The bullet defined in Claim 1, wherein said slug member is comprised of at least 94% zinc, and
   (c) a metal cartridge casing having head, rim, main body, and mouth portions;
   (d) primer compound located adjacent said rim portion and bearing against said head portion;
   (e) propellant located within said main body portion in close proximity to said primer compound; and
   (f) said slug member being secured within said metal casing with its cylindrical rear portion disposed within said mouth portion of said casing and having its tapered forward portion extending forwardly relative to said casing.
9. The bullet defined in Claim 1, wherein said slug member is completely encased in nylon.

AMENDED SHEET (ARTICLE 19)

10. The bullet defined in Claim 1, wherein said slug member is devoid of metal-encasing structure.
11. The bullet defined in Claim 1, wherein said slug member is constructed and arranged so as to retain 45-65% of its weight upon impact with a target.
12. The bullet defined in Claim 1, wherein said slug member is completely encased in copper.
13. A non-toxic rifle bullet comprising,
    (a) a generally cylindrical casing having a substantially closed rear end and an open forward end and being comprised primarily of copper, and
    (b) a core member secured within said casing and extending forwardly beyond the forward end thereof, said core member being comprised throughout primarily of zinc and having a generally cylindrical rear portion and an inwardly tapering forward portion and having smooth circumferential surfaces throughout.
14. The bullet defined in Claim 13, wherein said forward end of said casing terminates adjacent the forward portion of said core member.
15. The bullet defined in Claim 13, wherein said forward end of said casing is swaged inwardly around and against said inwardly tapering forward portion of said core member.
16. The bullet defined in Claim 13, wherein said core member is cylindrical in shape throughout substantially half of its length.
17. The bullet defined in Claim 13, wherein the rear portion of said core member is characterized by weakened areas designed to permit at least partial segment separation upon impact.
18. The bullet defined in Claim 13, wherein said core member has parallel rear end and nose surfaces.
19. The bullet defined in Claim 13, wherein said core member has an axially extending intermediate circumferential surface disposed within its tapering forward portion and extending parallel to said cylindrical rear portion.
20. The bullet defined in Claim 13, wherein said core member has an axially extending intermediate circumferential surface disposed within its tapering forward portion extending parallel to said cylindrical rear portion and said forward

end of said casing bears against said intermediate circumferential surface of said core member.

21. The bullet defined in Claim 13, wherein said core member is comprised of at least 94% zinc.

22. The bullet defined in Claim 13, wherein said core member is comprised of at least 94% zinc, and

(c) a metal cartridge casing having head, rim, main body, and mouth portions;

(d) primer compound located within said rim portion and bearing against said head portion;

(e) propellant located within said main body portion in close proximity to said primer compound; and

(f) said cylindrical casing and said core member being secured within said mouth portions of said metal cartridge casing in tight-fitting relation and extending forwardly therefrom.

23. The bullet defined in Claim 22, wherein a portion of said core member extending beyond the forward end of said cartridge casing is tapered inwardly throughout.

24. The bullet defined in Claim 13, wherein said core member has a rear end portion which is structurally weakened to facilitate rupture of said core member upon impact of said core member with a target.

25. The bullet defined in Claim 13, wherein said core member includes a plurality of separate segments encased within said casing and separating from each other upon impact of said core member with a target.

26. The bullet defined in Claim 13, wherein said core member has a rear end portion comprised of a plurality of weakened areas encased within a rear portion of said casing and separating from each other upon impact of said core member with a target.

27. The bullet defined in Claim 13, wherein said core member and said casing are constructed and arranged so as to retain 45-65% of its weight upon impact with a target.

28. The bullet defined in Claim 13, wherein said core member and said casing have weight-retaining characteristics such that said core member retains 15-35% of its weight upon impact with a target.

29. A non-toxic rifle bullet, comprising,
    (a) a generally cylindrical casing comprised primarily of copper,
    (b) a core member secured within said casing and being made primarily of zinc, and having a generally cylindrical rear portion and an inwardly tapering forward portion, a rear end, and circumferential surfaces throughout its length,
    (c) said casing surrounding said forward portion and the major portion of said circumferential surfaces in tight-fitting relation and extending rearwardly beyond said core member and across at least a portion of the rear end of said core member, and
    (d) said circumferential surfaces being smooth throughout.

30. The bullet defined in Claim 29, wherein said casing extends radially inwardly a short distance across the rear end of said core member.

31. The bullet defined in Claim 29, wherein said casing encases said tapering forward portion entirely.

32. The bullet defined in Claim 29, wherein said casing encases the entire exterior surface of said core member except for a central area of the rear end of said core member.

33. The bullet defined in Claim 29, wherein said casing has rear end terminal portions swaged over the rear end of said core member.

34. The bullet defined in Claim 29, wherein said core member is comprised of at least 94% zinc, and
    (c) a brass cartridge casing having head, rim, main body, and mouth portions;
    (d) primer compound located within said rim portion and bearing against said head portion;
    (e) propellant located within said main body portion in close proximity to said primer compound; and
    (f) said core member being secured within said cartridge casing with its cylindrical rear portion disposed within said mouth portion of said cartridge casing and having its tapered forward portion extending forwardly relative to said cartridge casing.

35. The bullet defined in Claim 29 wherein said core member and said casing have weight-retaining characteristics such that said core member retains 60-80% of its weight upon impact with a target.

STATEMENT UNDER ARTICLE 19

Submitted herewith, by separate letter, are a plurality of amendments to Claims 1, 4, 8, 11, 13, 22, 23, 27, 29 and 34 of the above-entitled application.

The amendment to Claim 1 merely inserts the term "rifle" ahead of "bullet". The purpose of this amendment is merely obviate any possible misunderstanding through a misinterpretation of shotshell pellets, as constituting bullets.

The amendment to Claim 4, which has been made by separate letter, consists of inserting "is constructed and arranged so as to retain" for the word "retains". The purpose of this amendment is to obviate any possible objection to the use of the term "retains" as being merely functional. As was alleged in the corresponding U.S. Application Serial No. 08/378,797.

The amendment to Claim 8, as made by separate letter submitted herewith, merely constitutes the insertion of "wherein said slug member is comprised of at least 94% zinc" ahead of the word "and", in line 1 of that claim. Through this amendment, Claim 8 clearly limits the claim from which it is dependent, Claim 1, and, therefore, becomes a proper dependent claim.

By the amendment to Claim 11, the term "is constructed and arranged so as to retain" is substituted for "has weight-retaining characteristics such that it retains". By this amendment, Claim 11

is no longer subject to objection on the ground that it is merely functional, as was alleged in an action on U.S. Application Serial No. 08/378,797.

By the amendment to Claim 13, the term "rifle" was inserted ahead of the term "bullet", in line 1. As indicated, with respect to Claim 1, "rifle" is inserted so as to clearly distinguish from shotgun pellets.

By the amendment to Claim 22, the term "wherein said core member is comprised of at least 94% zinc" has been inserted in line 1 immediately ahead of the word "and". By this amendment, Claim 22 clearly limits Claim 13, from which it is dependent and, therefore, clearly becomes a proper dependent claim.

By the amendment to Claim 23, line 1, the word "a" has been substituted for the word "the". By this amendment, any objection to the indefinite use of the word "the" has been obviated.

Claim 27 has been amended by substituting "are constructed and arranged so as to retain" for "have weight-retaining characteristics such that said core member retains". This amendment was made to overcome any possible objection that the claim in its original form was purely functional.

Claim 29 has been amended by inserting the term "rifle" ahead of "bullet" in line 1. This amendment was made to clearly distinguish between rifle bullets and shotgun pellets, the latter being in unrelated art. Claim 29 has also been amended to cancel "cylindrical" from line 4 of subparagraph (b), and to insert "throughout its length", in line 4, after "surfaces". This amendment was made to clearly distinguish the claim from various prior art in which the circumferential surfaces are not cylindrical throughout their length.

Claim 34 has been amended to insert "wherein said core member is comprised of at least 94% zinc", in line 1, immediately ahead of the word "and". This amendment was made to make the claim more clearly distinguishable over the various references which may suggest the inclusion of zinc in the core, but carry no indication of the

percentage of zinc which would be utilized, or else specify a much lower percentage thereof to be used. This amendment was also made to make Claim 34 limiting the contents of its independent claim, Claim 29.

The above amendments have been made in order to bring the claims of the instant PCT application into full agreement with the amended claims of U.S. Application Serial No. 08/378,797, which is the patent application under which priority is claimed. It is believed that, by these amendments, this purpose has been accomplished.

Fig.-1 (PRIOR ART)

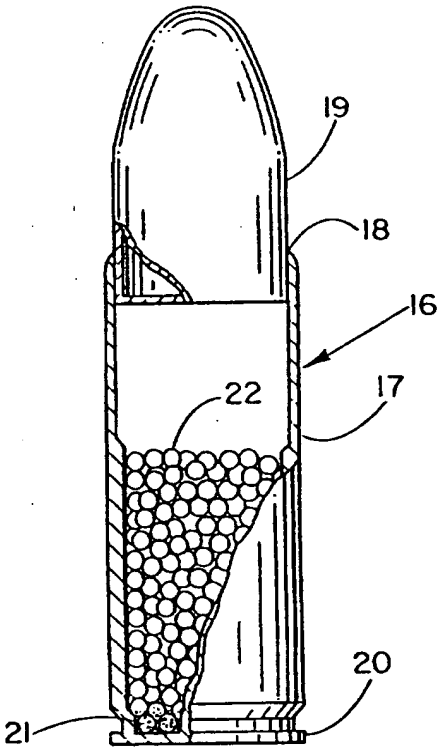


Fig.-2

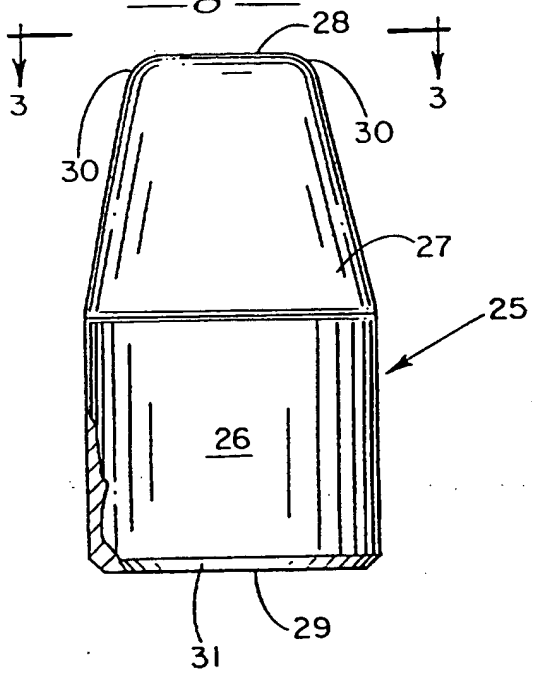


Fig.-3

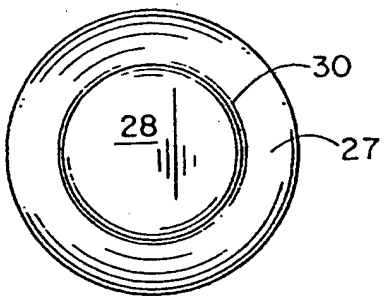


Fig.-4

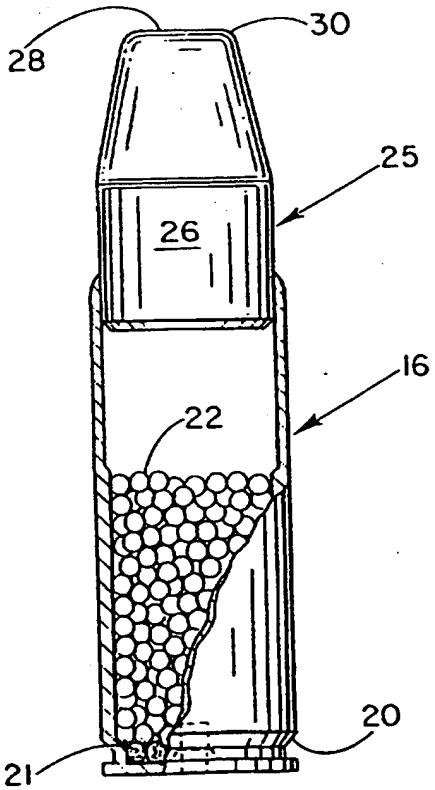


Fig.-5

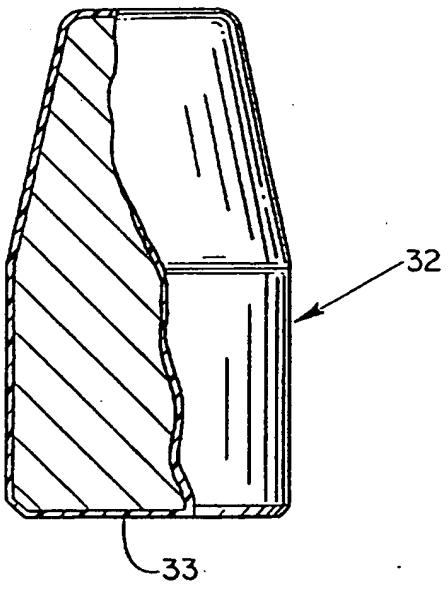


Fig.-6

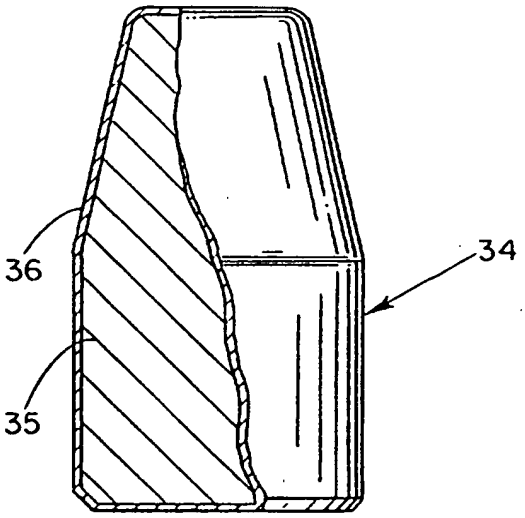


Fig.-7

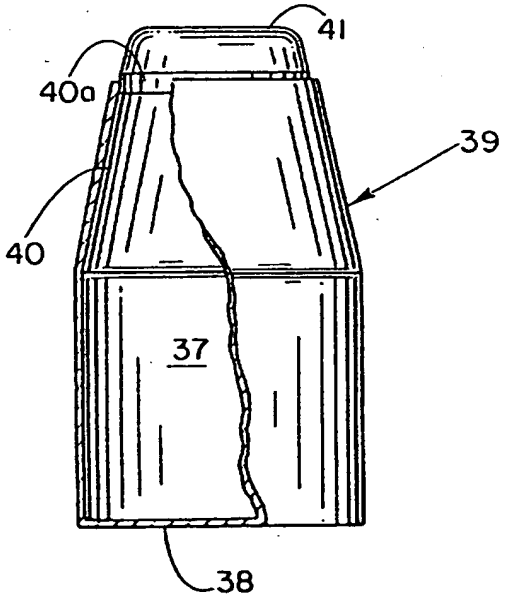


Fig.-8

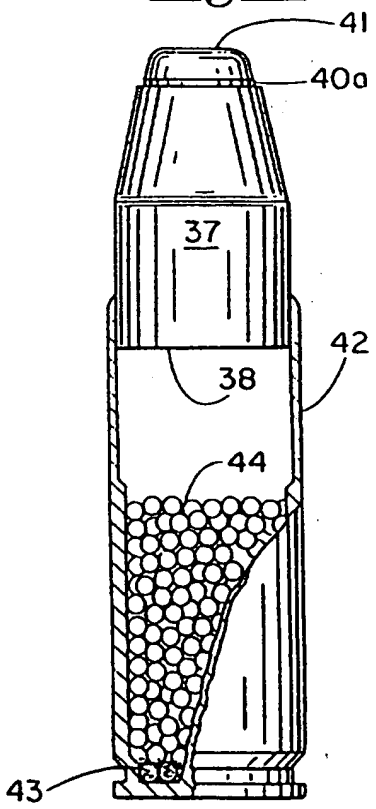


Fig.-9

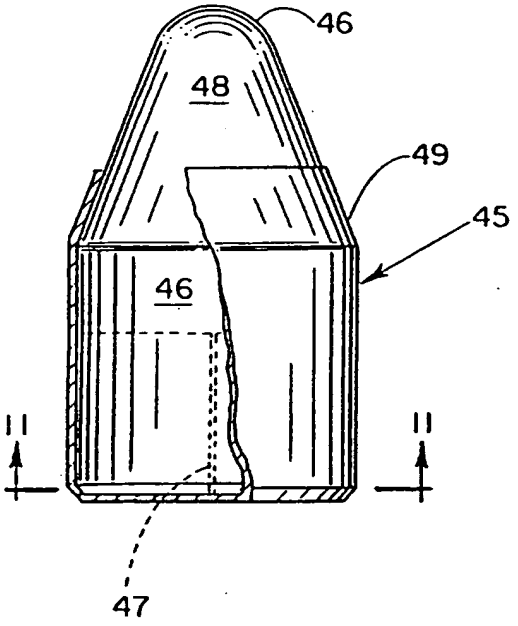


Fig.-10

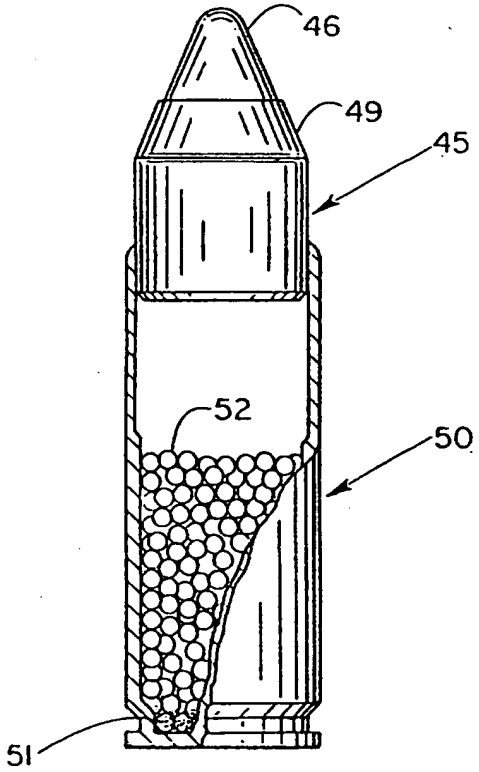


Fig.-11

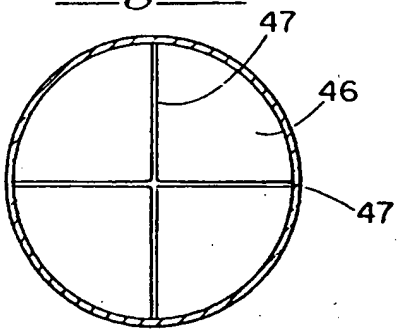


Fig.-12

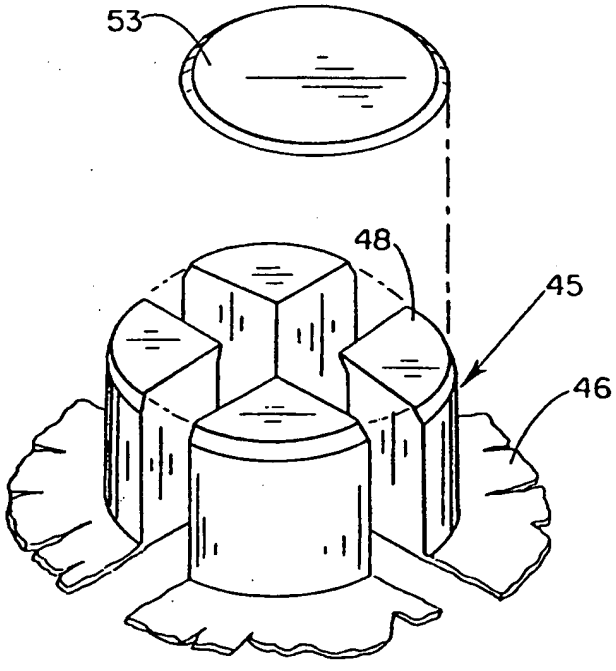


Fig.-13

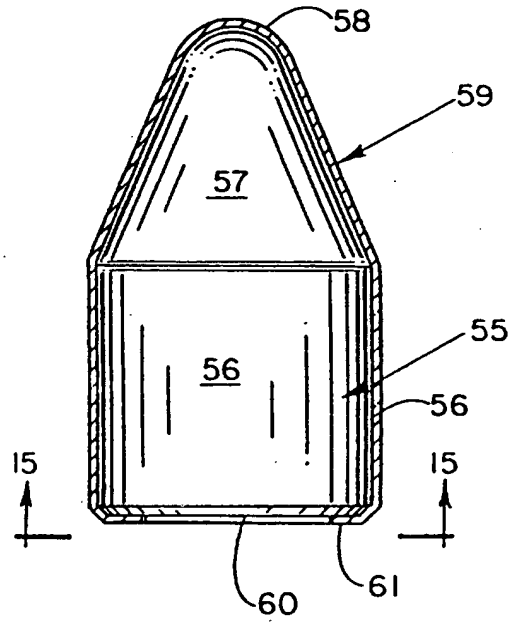


Fig.-14

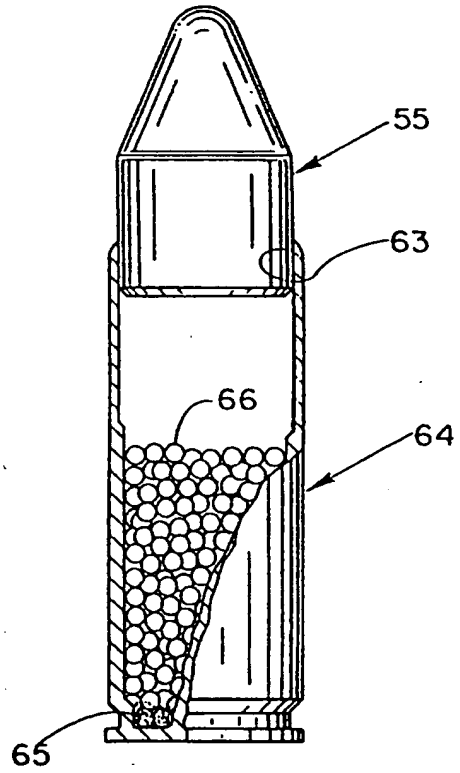
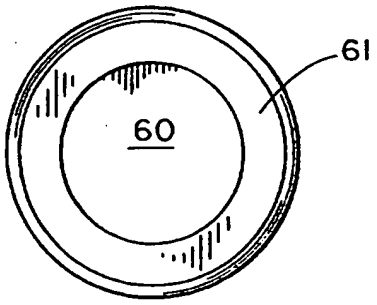


Fig.-15



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/06093

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :F42B 5/02
US CL :102/439

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 102/439, 471, 506, 507, 508, 509, 510, 514, 515, 516, 517, 518, 529

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, (Projectile # or Bullet #) + Zinc + class 102

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P --- Y	US, A, 5,394,597 (WHITE) 07 March 1995, See Figure 4 and column 4, lines 10-25.	1-4, 6, 7, 11, 12, 29, 30, 31, 35 --- 8, 34
Y	US, A, 1,107,519 (HOAGLAND) 18 August 1914, see entire document.	8, 22, 23, 34
Y	WO, A, 92 08097 (BROWN) 14 May 1992, see Figures 1 and 3, page 2, lines 1-34 and page 2, lines 1-23.	1-8, 10-12, 29-31, 34 and 35
Y	GB, A 2,211,920 (HAINES) 12 July 1989, see entire document.	1-35
Y	US, A, 4,328,750 (OBERG ET AL) 11 May 1982 see Fig. 1 and Abstract.	1-4, 6-9, 11

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 AUGUST 1995	05 OCT 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer HAROLD TUDOR Telephone No. (703) 308-0497

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/06093

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 338,849 (LORENZ) 30 March 1886, see Figures 4 and 5 and page 1, lines 1-102.	1-4, 6-8, 11, 12, 29-35
Y	DE, A, 126,943 (TAYLOR) 02 January 1902, see entire document.	1-4, 6-8, 10, 13-16, 18, 21-23, 27, 29, 30, 34, 35
Y	US, A, 1,096,558 (NEWTON) 12 May 1914, see Figure 1 and page 1, lines 80-88.	1-4, 6-8, 11, 13-16, 19-23, 27, 29, 30, 34, 35
Y	US, A, 1,080,974 (JOHNSON) 09 December 1913, see Figure 2 and page 1, lines 69-76.	19, 20
Y	DE, A, 3,840,165 (SCHIRNEKER) 05 July 1990, see Figures 1 and 2 and column 4, lines 5-27.	1-3, 6-8, 13, 14, 16-18, 21-26, 28
A	US, A, 4,517,898 (DAVIS ET AL.) 21 May 1985.	
A	US, A, 4,676,169 (MAKI) 30 June 1987.	
A	US, A, 4,805,536 (KOSTECK) 21 February 1989.	
A	GB, A, 27,342 (HOOKHAM) 19 September 1907.	
A	GB, A, 14,659 (TAYLOR) 29 April 1899.	